

MAE Seminar Announcement

MONDAY March 17 4:15PM, Truitt Auditorium, Br 1402

The hydrodynamics of ionic liquids near charged interfaces and some modern applications

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ABSTRACT:

The great strength of electrostatic forces makes liquids charge neutral at all length scales larger than the Debye length which is typically between 1 and 10 nm for typical electrolytes. Therefore, charge separation takes place only in thin interfacial layers and the electrostatic force, like other surface forces (e.g. surface tension) scales with the area rather than the volume of the liquid mass. Therefore, electrostatic interactions start to play an important role in hydrodynamics only at small length scales, typically at 100 microns or less. For example, electrostatic forces can actually drive a fluid flow: electro-osmotic flow that has important practical applications in microfluidics. Electrophoresis, the electric field driven motion of charged macromolecules and colloidal particles in an aqueous medium, is at the heart of DNA sequencing technologies. The Brownian dynamics of charged polymers in ionic fluids determine how the machinery of biological systems functions at the cellular and sub-cellular levels. In this talk I will first develop the mathematical tools for describing such small scale electrically driven fluid flows and then illustrate with some modern applications in biotechnology.

BIOGRAPHICAL SKETCH:

Dr. Sandip Ghosal is Associate Professor of Mechanical Engineering at Northwestern University. Dr. Ghosal received the Bachelor of Science (with Honors in Physics) from Presidency College, Calcutta (India) and the M.Phil and Ph.D. in Physics from Columbia University (New York). He has held post doctoral positions at the Center for Turbulence Research (Stanford University and NASA Ames Research Center), Center for Nonlinear Studies (Los Alamos National Laboratory), Combustion Research Facility (Sandia National Laboratory) and was a visiting faculty at INSA de Rouen (University of Rouen and CNRS-CORIA) in France. Dr. Ghosal has worked on a broad range of topics in fluid mechanics including Astrophysical and Geophysical flows, Turbulence Modeling, Laser Plasma interactions and Combustion. Presently his research focus is on the flow of ionic liquids near charged interfaces and its applications to micro and nano scale systems in biology and biotechnology. Dr. Ghosal has held a number of society positions such as the Vice Chair (2006) and Chair (2007) of the Acrivos Dissertation Award Committee of the American Physical Society and Chair of the 2009 program on "Complex Fluids and Complex Flows" of the Institute of Mathematics and its Applications (IMA). Dr. Ghosal was a Fellow of the Geophysical Fluid Dynamics Program (Woods Hole Oceanographic Institution) and a NASA ASEE fellow. He has authored a number of influential review articles including contributions in Electrophoresis, The Annual Review of Fluid Mechanics and contributions in two forthcoming encyclopedias from Springer: "Encyclopedia of Micro and Nano-fluidics" and "Encyclopedia of Complexity and Systems Science".